170-160.48

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FIG I.

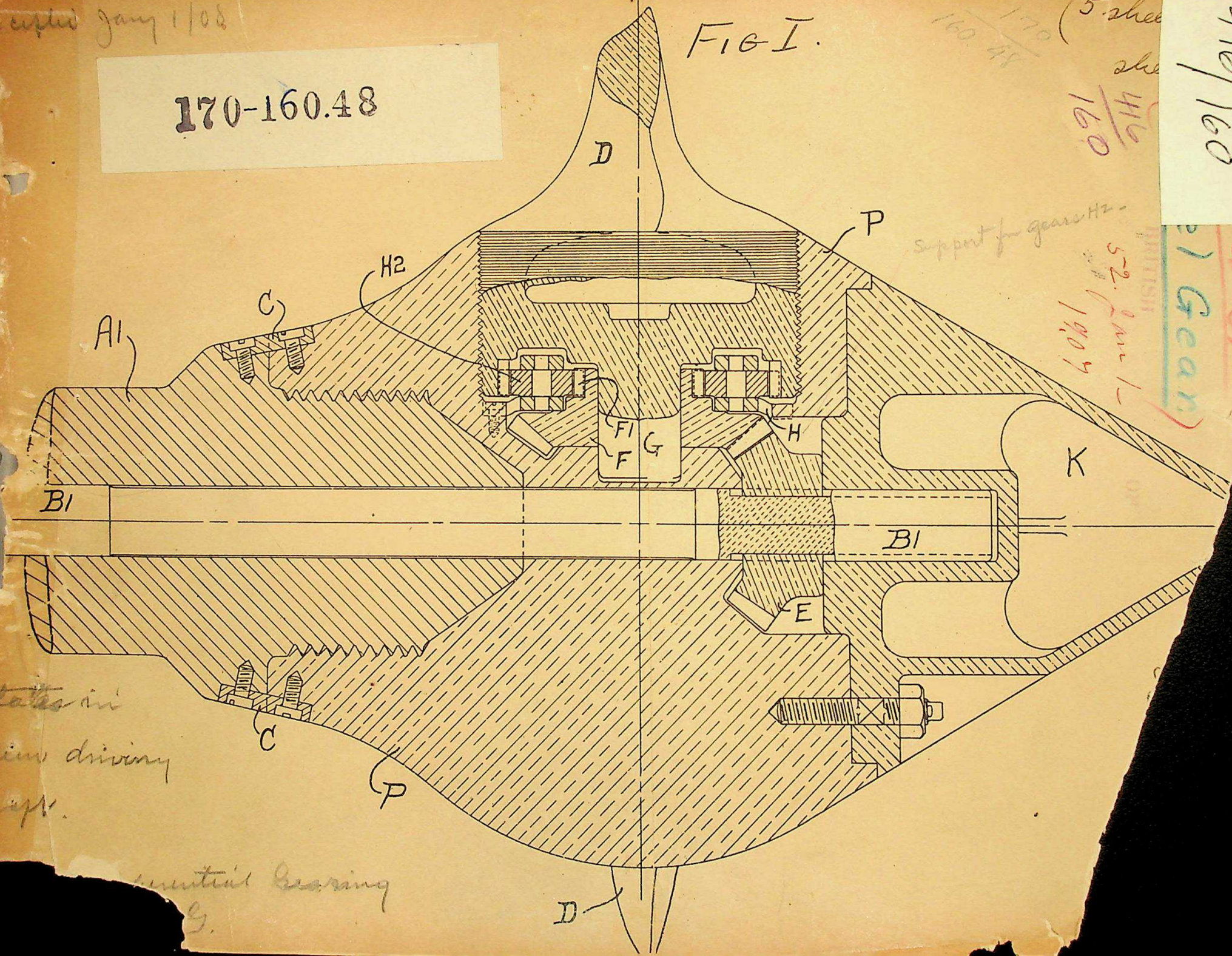

FIG II

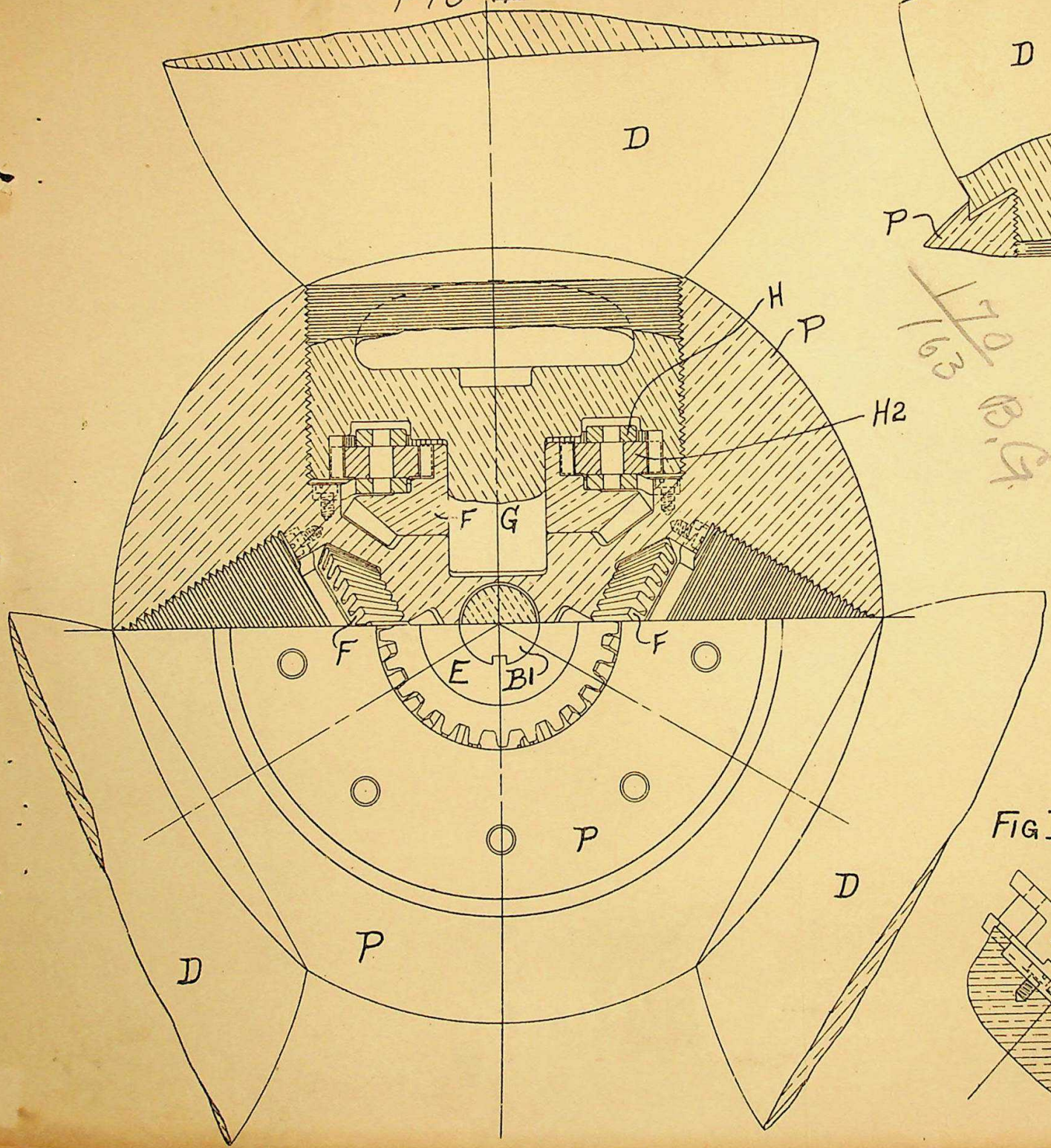

FIG V

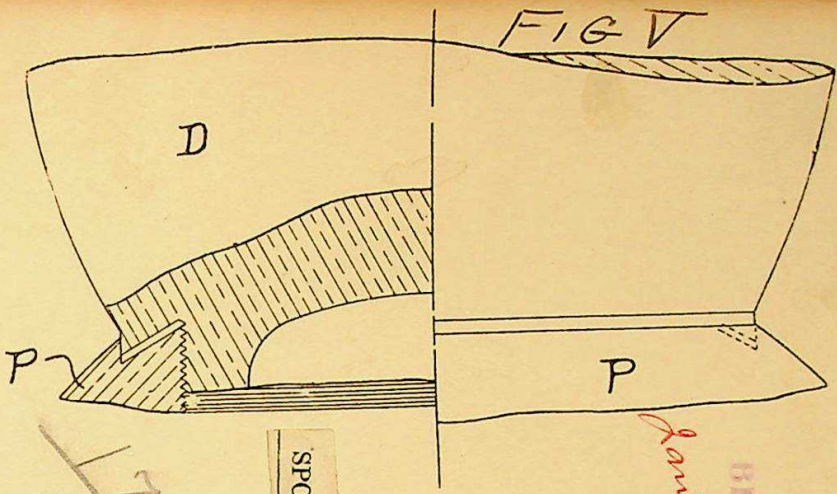

FIG III

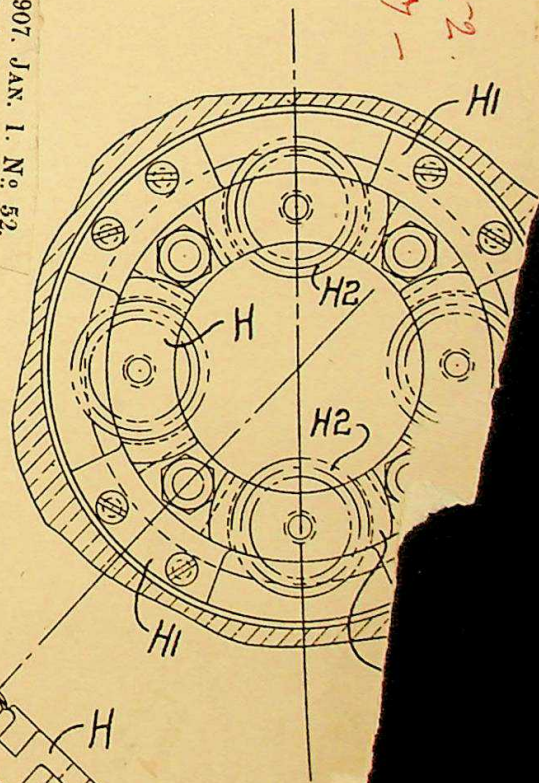

FIG IV

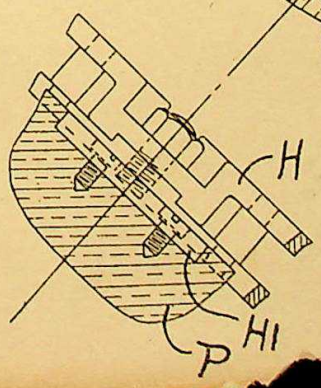

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FIG VI

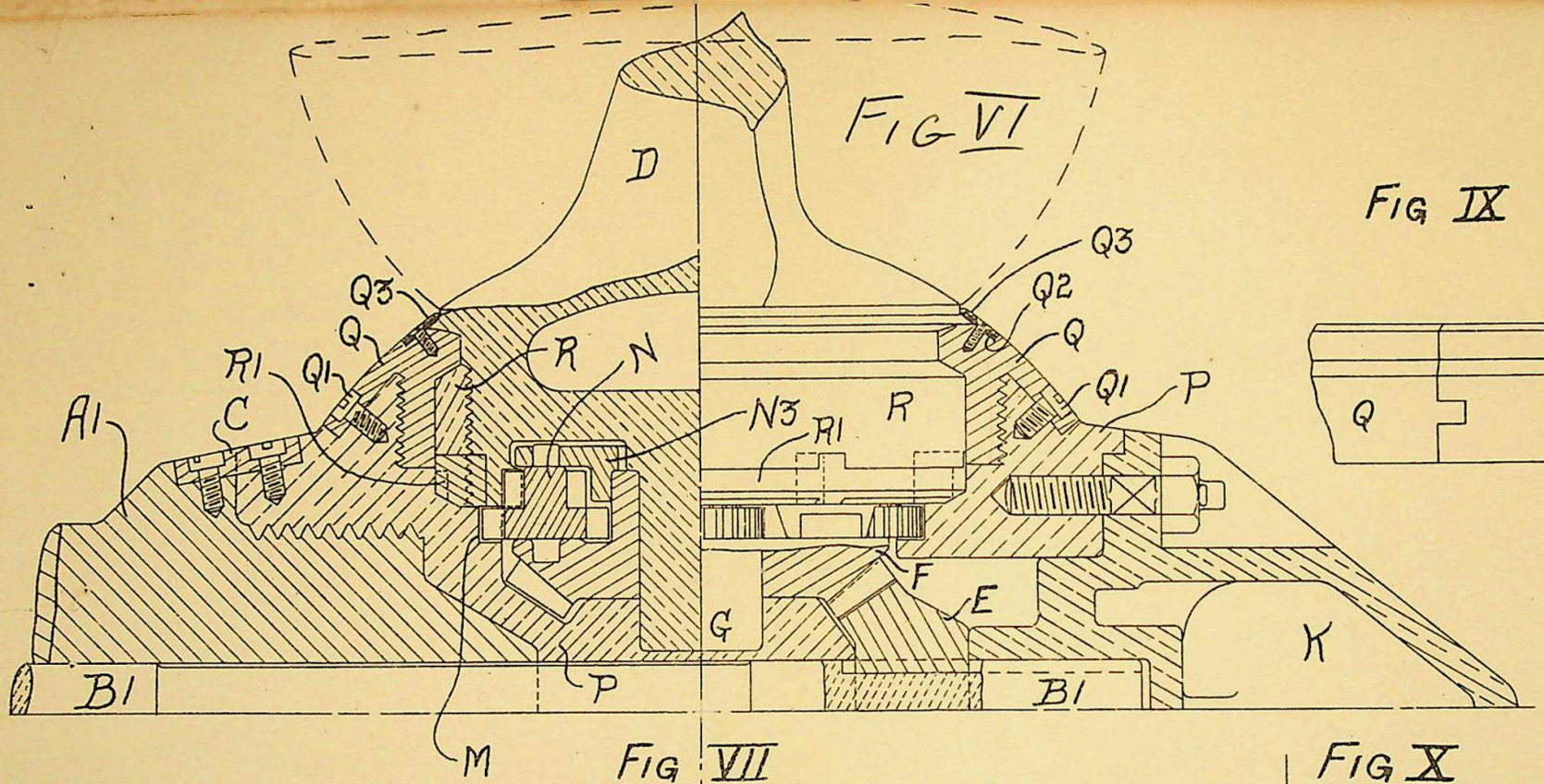


FIG IX

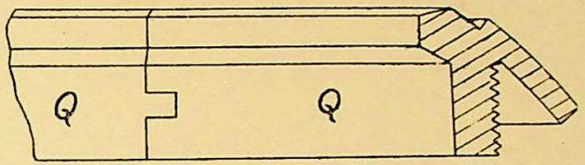


FIG VII

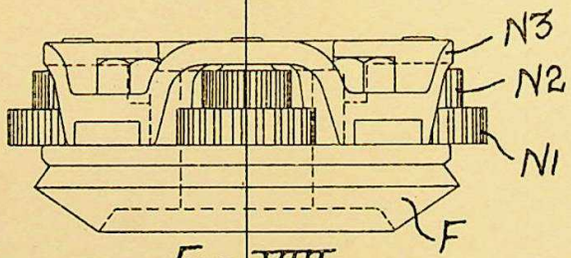


FIG VIII

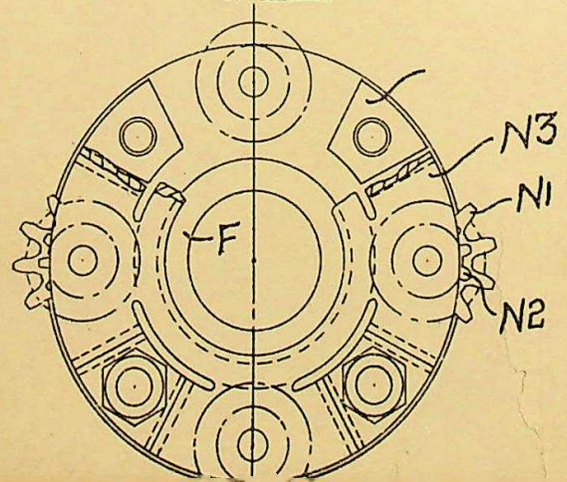
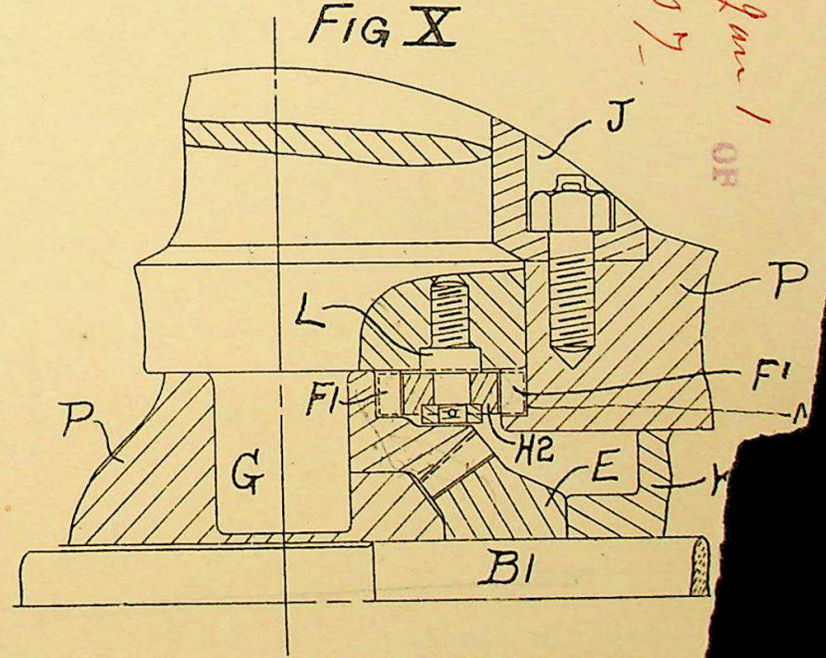


FIG X



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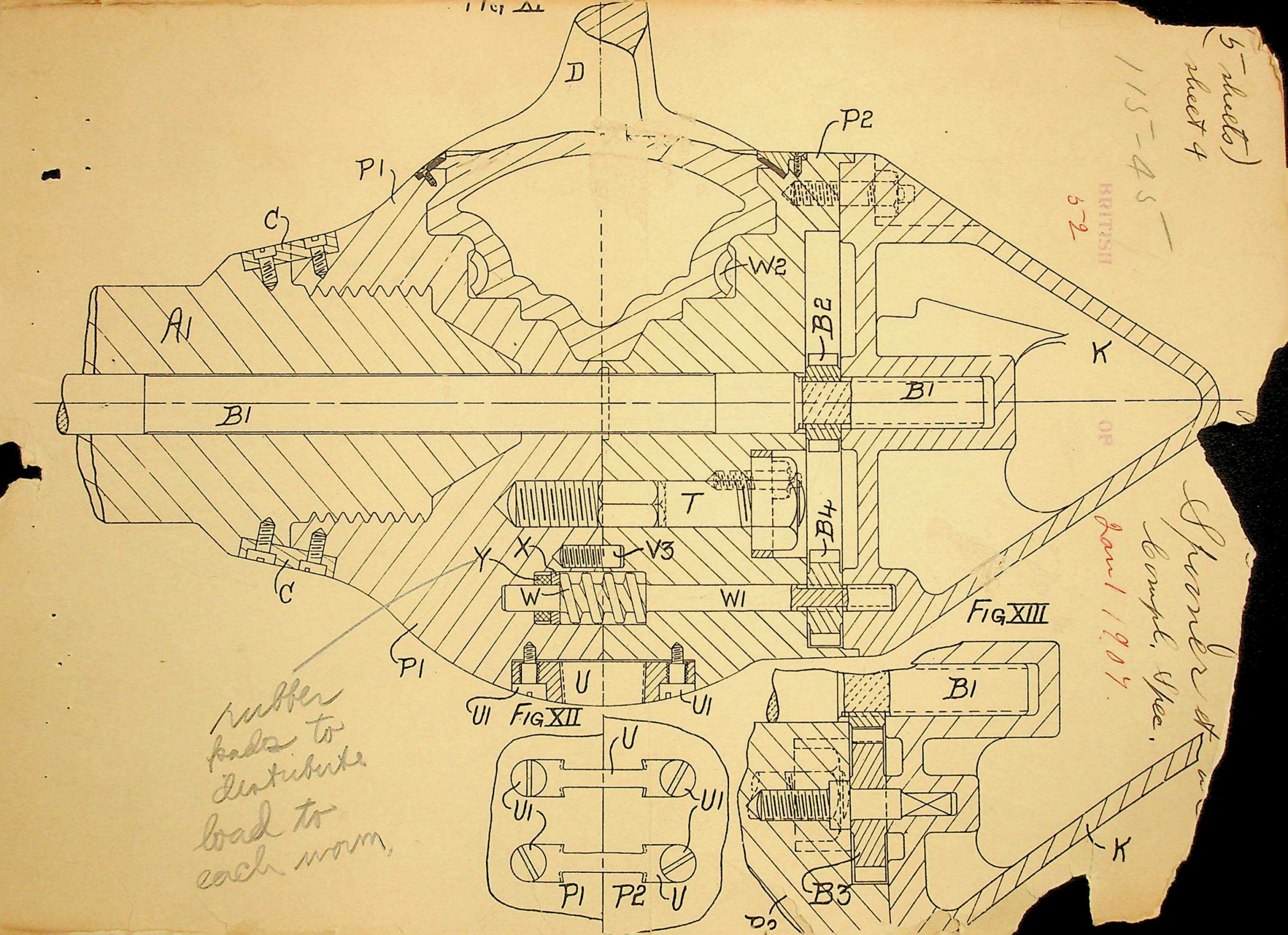
D
P2
P1
C
W2
A1
B2
K
B1
B1
T
B4
V3
Y
X
W
W1
C
P1
U
U1
U1
FIG XII
U
U1
U1
P1
P2
U
B1
K
B3
D2
FIG XIII
rubber
loads to
distribute
load to
each worm.

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sheet 5 b.

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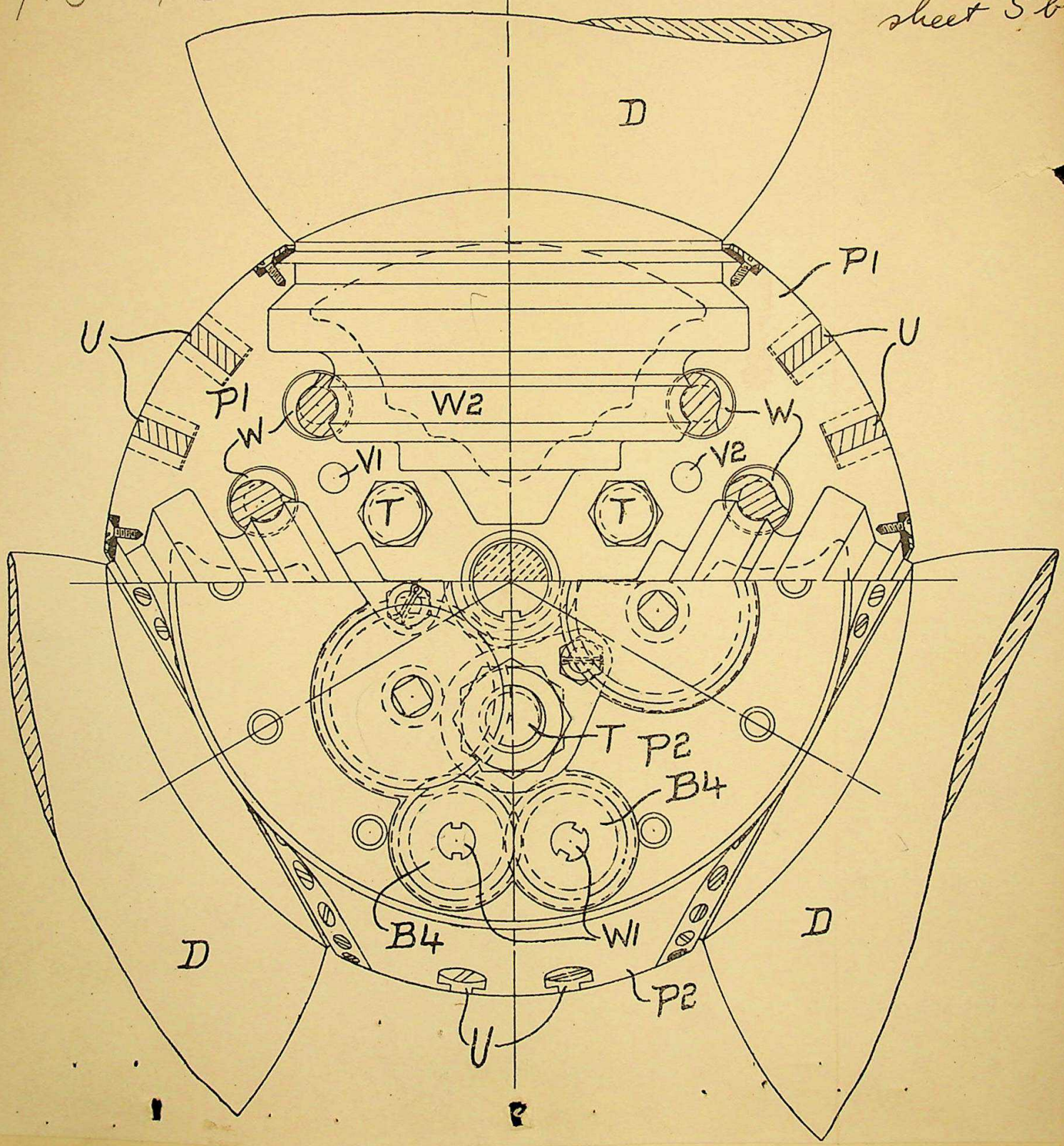
FIG XIV.



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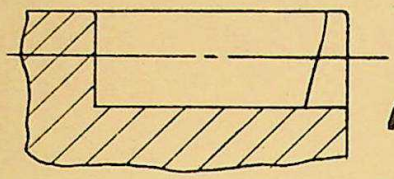


Fig. XV.

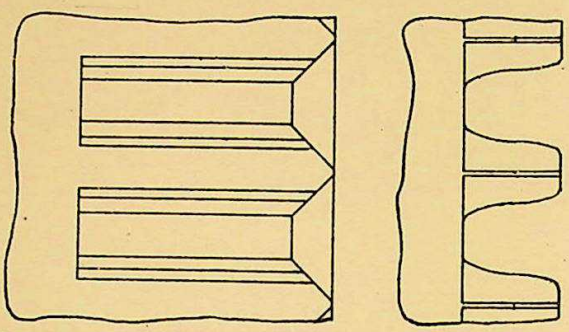
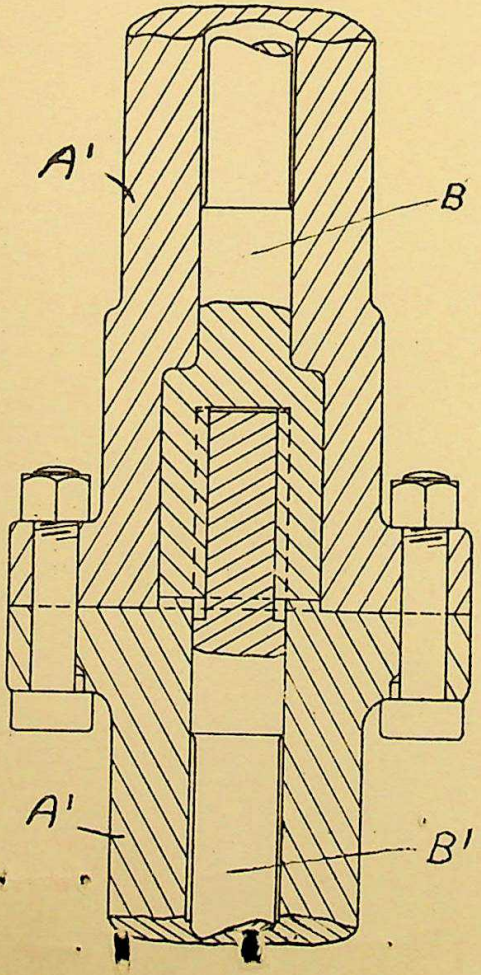


Fig. XVI



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N° 52 A.D. 1907

Date of Application, 1st Jan., 1907
Complete Specification Left, 1st July, 1907—Accepted, 1st Jan., 1908

PROVISIONAL SPECIFICATION.

Improvements connected with Reversing Propellers.

We Henry John Spooner, of 311 Regent Street, London, W., Civil Engineer, and Philip Owen Penrose, of 106 Upper Richmond Road, Putney, London, S.W., Mechanical Draughtsman do hereby declare the nature of this invention to be as follows.—

This invention primarily applies to propellers for use on the hollow driven shaft of steam turbines. The propeller blades are operated by rotating a solid shaft passing through the hollow propeller shaft. We arrange the blades so that they can be revolved in their sockets into positions for going ahead, astern, or stopping, by the differential motion of the two shafts which we utilise to operate certain gears on or within the propeller boss. We may screw part of the spigot end of each blade and cut a screw thread in each socket of the boss to receive it, so that each blade can be screwed into the boss in such a perfect way that its necessary rotation about its axis for feathering purposes can be made with little resistance and practical fluid tightness, and giving a strong and rigid connection of blade to boss. To ensure the perfect lubrication of the gears in the boss we supply it with oil under pressure in access of that of the water at the level of the boss, so that there is a constant weeping of the oil past the screw threads, keeping these parts efficiently lubricated, and preventing the leakage of the water into the boss.

We fit and fix to the part of the solid shaft which enters the boss of the propeller, a bevel pinion geared to a bevel wheel free to run on a tail piece of the spigot of each blade. We may produce the desired rotation of the blades in their sockets in either of the following ways.

(*a*) We form the boss of each bevel wheel into a spur pinion and form the end of the spigot of each blade into an internal toothed wheel or ring, and employ change wheels (running on studs which are attached to the boss of the propeller by means of a suitable plate) to gear one with the other. This gear connects the spigots of the blades to the solid shaft in such a way that the differential angular velocity of the latter causes the blades to move with a slow angular velocity about their axis. This angular velocity of the blades we may still further reduce by using pairs of stud wheels and pinions, instead of the simple pinions described. The bevel wheel boss pinions then gear into the stud wheels, and the stud pinions which rotate with them, gear into an internal toothed annulus on the spigot of the blade in each case.

(*b*) We may gear the pinion on the boss of each bevel wheel to an internal toothed annulus fixed to the boss of the propeller, through intermediate change wheels running on studs fixed to the spigot end of each blade, so that the change wheels have an epicyclic motion about the bevel wheel and a hypocyclic motion around the annulus, allowing the differential motion of the two shafts (the solid one and hollow one) to move the blades about their axis as may be required.

(*c*) We may arrange pairs of stud wheels to run on studs fixed to the back of each bevel wheel, with their axis parallel to the axis of the wheel, and

these stud wheels to gear into two internal toothed annuli, one forming part of the propeller boss, and the other part of the spigot end of the blade; and then giving the diameters of the two wheels which run together on each stud, a suitable ratio. The angular velocity of the blades about their axis can be reduced in any required ratio in relation to that of the differential angular velocity of the shafts.

(*d*) We may run the solid shaft through the boss of the propeller and fix to its end a spur wheel and cause this to drive a pinion for each blade used, each pinion being fixed to a worm geared to a worm wheel which is suitably fixed to the spigot end of each blade, by this arrangement the blades are caused to slowly revolve about their axis when a differential motion of the two shafts occurs.

Dated this 1st day of January 1907.

FREDERIC PRINCE,
Agent for Applicants

COMPLETE SPECIFICATION.

Improvements connected with Reversing Propellers

We HENRY JOHN SPOONER, of 311 Regent Street, London, W., Civil Engineer, and PHILIP OWEN PENROSE, of 106 Upper Richmond Road, Putney, London, S.W., Mechanical Draughtsman, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained, in and by the following statement.—

This invention relates to a form of propeller of variable and reversible pitch suitable for use on the hollow driven shaft of steam turbines, but is also otherwise suitable where a reversing propeller is required.

This form of propeller is particularly designed for use in connection with our invention described in the Specification of our Letters Patent No. 3976—1906.

It is to be understood that the hollow and solid shafts marked A^1 and B^1 respectively and shown in the accompanying drawings are the same as those referred to by the same letters, in the drawings of the specification of the above mentioned letters patent.

Figure 1 a longitudinal sectional view of a propeller boss and parts with the blades of propeller broken off.

Figure 2 a partial cross sectional view.

Figures 3 4 and 5 detached views of parts embodied in the previous figures.

6 partial cross sectional view of part of boss illustrating certain internal arrangements of modified construction.

Figures 7 8 9 10, detached views of parts embodied in Figure 6.

Figure 11 a modified longitudinal sectional view of a boss and internal arrangements.

Figures 12 and 13 detached views illustrating parts embodied in Figure 11.

Figure 14 an end view of boss of a further modified form with portion of outside removed.

Figures 15 and 16 detached views of parts embodied in Figure 14.

The boss P of the propeller is affixed to the hollow shaft A^1 by means of

a screw thread which we arrange to make left or right handed according as the rotation of the shaft (viewed from astern) is clockwise or counter-clockwise, whereby the tendency of the propeller is always to screw onto the shaft, since any particular shaft revolves in one direction only. As an additional security a number of short keys or snugs C are sunk into recesses cut to receive them after the boss has been screwed home on the shaft, these keys being retained in position by set screws as shown.

We will now proceed to describe our invention and modifications thereof by which the motion of the solid shaft B^1 relatively to that of the propeller boss P and hollow shaft A^1 may be transmitted to the propeller blades D.

In all the drawings propellers having three blades are shown, but it is to be understood that either two, three, or four blades may be employed.

It will also be observed that in all the views the blades are shown in the neutral or mid-position, the stern face of the blade in each case being of less convexity or flatter than the forward face as is customary for propellers designed to work only on the stern face, this ensures that the usual efficiency is maintained when going ahead.

Sheets 1 and 2 of the accompanying drawings illustrate the principal method of carrying our invention into practice. According to this arrangement each of the blades D is (as has previously been proposed) screw threaded at its spigot end as shown and thereby fixed to the boss P in a socket which is correspondingly screwed to receive it. The bevel pinion E revolves with the solid shaft B^1 whilst allowing the latter a little play in the direction of its axis the said bevel pinion E gears with and drives the three bevel wheels F which are free to rotate upon the tail pieces G of the blades D, these bevel wheels being restrained from any movement in the direction of the axis of the blades by the frame H which is securely fixed as a part of the boss by the four projections or lugs H^1 these being sunk into the recesses in the boss and screwed thereto as shown in Figures 3 and 4, the said frame H bearing upon the bevel wheel F and so preventing it from lifting (see Figure 1) whilst leaving it free to rotate about its axis, the said frame or plates H carry the change wheels H^2 which engage with the spur pinion F^1 formed upon the bosses of the wheels F and an annular wheel in the blade spigot so that any rotation of the shaft B^1 relatively to the propeller boss P is directly transmitted to the blades D so varying or reversing their pitch. The part of the blade spigot which just emerges from the propeller boss under working conditions may be formed as is shown in Figure 5 as a precaution against possible damage to the screw thread and the plane surface so obtained may be fitted with a leather collar or cup-leather of any usual pattern, for the exclusion of water and to assist in preventing the oil (used in lubricating the working parts of the propeller and supplied as hereafter explained) from escaping. The cup K closes the end of the boss and provides a bearing for the back of the bevel pinion E and also for the extremity of the shaft B^1.

A modification of the above is illustrated at Sheet 3. The change wheels H^2 which gear with the spur pinions formed on the bosses of the bevel wheels are pivotted on studs L fixed to the spigot end of each blade and gear with an internal toothed annulus M formed in the material of or fixed to the boss of the propeller, the rotation of the solid shaft B^1 in this case causes the change wheels H^2 to travel hypocyclically around in the boss thereby rotating the blades D about their axis.

Figure 10 shows an alternative method of fixing the blades in the boss, that is by means of a collar or ring J bolted into the boss and bearing upon an enlarged portion of the blade spigot, the ring J being made in two pieces divided in a manner similar to that suggested hereafter for the collar Q see Figure 9.—

A further modification would be that no teeth are formed on the bosses of the bevel wheel F but a series of double stud wheels N are pivotted on its

back, the lower portion N^1 of each gearing into the internal toothed annulus M and the upper portion N^2 into a similar annulus formed in the spigot of the blade. The method of mounting the double stud wheels N upon the bevel wheels F is shown in Figures 7 and 8, the framework N^3 providing a top bearing for the pivots of the stud wheels. This gearing affords a means of giving the blades the slowest possible revolution about their axis for a given speed of the solid shaft B^1 within the boss.

Figure 6 also shows an alternative method of fixing the blades in the boss, the collar Q being first placed upon the spigot of the blade and the ring R screwed home so that the blade D is still free to revolve in the collar Q the securing ring R^1 having radially projecting keys formed upon it at intervals, is then put into place to prevent the ring R slacking back, after this the blade is put into position by screwing the ring Q into the socket in the boss suitably screw threaded to receive it which may be done by means of a special wrench fitting into the holes provided for the set screws Q^1 the leather collar Q^2 being then put in place and the plate Q^3 placed on the top and screwed down, the said leather ring (or collar) and plate may be made divided if necessary to facilitate getting them into position. The ring R may be dispensed with if the collar Q be made in two pieces as shown in Figure 9, the spigot being then made solid as in Figure 10.

Figures 11, 12, 13, 14, illustrate how the above described invention may be varied. In this method the boss of the propeller is made in two sections P^1 P^2 to facilitate placing worm wheels W in position, the two halves being rigidly fixed together by means of the studs T. This division of the boss also affords a ready means of securing the blades in position, the two halves P^1 and P^2 are further held together on the circumference by means of six tension cotters U arranged in pairs which after being driven home may be held in position by the tap bolts U^1, to extract the cotters the tap bolts are first removed and extraction bolts used which work in the threaded part of the cotter and bear on the bottom of the hole (after the manner of extracting large sunk keys from crank shafts.

V^1 V^2 V^3 (Figures 11 and 14) are studs to assist in maintaining the correct alignment of the two halves of the boss P^1 and P^2. Figure 14 show these studs in their true position which is not strictly as shown in Figure 11. The shaft B^1 has a spur wheel B^2 fitted in key ways upon it and gearing through change wheels B^3 to the pinions B^4 each of the said pinions B^4 is mounted upon one of the worm shafts W^1 which are therefore rotated by any motion of the shaft B^1 relatively to the boss P thereby rotating the propeller blades D through the operation of the worms W upon the worm wheels W^2 which form part of the spigot of the blades D each blade is revolved by two worms which revolve in contrary directions one on each side of the blade to ensure that both worms contribute equal turning moments, they are fitted on their forward sides with brass rings X and rubber pads or rings Y these being so adjusted that the worm which takes its reaction off the forward side shall engage with the worm wheel first by which means the rubber rings Y will be compressed until the other worm takes its share of the turning moment in order to make both worms bear as equally as possible. The wheels B^2 B^3 B^4 should be made without backlash.

To facilitate the assembling of the parts the edges of the teeth which first come together as the blade is being put in position may be tapered as shown in Figure 15, this would apply to the bottoms of the teeth formed internally in the end of the blade spigot and the top edges of the teeth in the change wheels H^2 and of the stud wheels N.

Figure 16 depicts a suitable form of shaft coupling for use with mechanisms of this type.

A propeller according to this invention may be lubricated by forcing oil

under pressure along the surface of the solid shaft (this being slightly grooved on the journals if found necessary) and then either allowing the oil to weep out between the blades and the boss or else allowing it to flow through a spring valve (adjusted to offer a suitable resistance) into the hollow space of the cup K this being emptied whenever the ship is docked, or else fitted with a gland and pipe so that the oil may be returned as suggested in the Specification of our Patent No. 3976—1906.

Having now particularly described and ascertained the nature of this invention and in what manner the same is to be performed, we desire to state that we are aware that reversing propellers at this date are not novel, and that we make no claim to securing the blades to the boss by a screwed spigot end but we declare that what we claim is.—

1—The arrangements of parts forming a reversing propeller hereinbefore described and illustrated by the accompanying drawings.

2—In a reversing propeller, the modified arrangement for securing and operating the blades and constructing the boss hereinbefore described and illustrated by Figures 11, 12, 13, 14, of the accompanying drawings.

3—In a reversing propeller, the manner of operating the blades from the shaft B^1 as described and illustrated at Figures 1, 2, 3, 4, 5, 6, of the accompanying drawings.

Dated 29th June 1907.

FREDERIC PRINCE,
4 Mitre Court, Temple, London,
Agent for Applicants.

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